Appendix A: Broad user Survey

THE QUESTIONNAIRE

Q1: Specify your institution type

- o   University / Research institute
- o   Governmental / International organization
- o   Commercial sector
- o   Non-governmental organization

Q2: In which application are you using GLOBCOVER?

- o   Cartography
- o   Climate / Meteorology / Hydrology
- o   Natural resources (Agriculture, Forestry, Biodiversity)
- o   Remote Sensing
- o   Information Technology / GIS

Q3: What are the land cover spatial resolution requirements for your application?

- o   < 300 m
- o   300 - 1000 m
- o   > 1 km

Q4: How often do you want to have an updated land cover product?

- o   Yearly
- o   Every 5 years
- o   Every 10 years

Q5: What types of classes are the most important for your application?

(multi-answer is possible)

- o   All - no particular interest in any class
- o   Tree cover/forest classes and subcategories
- o   Shrub classes
- o   Herbaceous classes
- o   Barren land classes
- o   Agricultural classes
- o   Urban classes
- o   Wetland classes
- o   Other specific classes

Q6: For which land cover changes are you mostly interested in, if any?

- o Forest changes
- o Urban sprawl
- o Desertification
- o Agriculture intensification

Q7: For the GlobCover MERIS composites, which composition period is the most appropriate for your application?

- o Daily
- o Weekly
- o Bi-weekly
- o Monthly
- o Bi-monthly

Q8: Is the Land Cover Classification System (LCCS) suitable for your application?

- o Yes
- o No, propose alternative... [**free text inpu**t]

Q9: How do you prefer to download the GlobCover MERIS composites?

- o FTP
- o HTTP
- o Torrent

Q10: How do you prefer to download the GlobCover land cover map?

- o FTP
- o HTTP
- o Torrent

Q11: What is the most suitable file format for the GlobCover MERIS composites?

- o GEOTIFF
- o HDF-EOS
- o NetCDF

Q12: What is the most suitable file format for the GlobCover land cover map?

- o GEOTIFF
- o HDF-EOS
- o NetCDF

Note: If you wish to advertise your publication making use of GlobCover, please email a .pdf version to due@esa.int

Appendix B: Associate User Survey

A. General Information

– **Name and institution/organization of whom completed the survey:**

– **What is your Earth system/ climate modeling focus (tick all that may apply)**
  - o Global circulation modeling
  - o Dynamic vegetation modeling
  - o Carbon (stock) modeling
  - o Land use/cover (change) modeling
  - o ecosystem modeling
  - o land surface modeling
  - o plant-soil-carbon modeling
  - o nutrient-cycling modeling
  - o coupled earth system modeling (e.g. atmosphere-ocean-biosphere modeling)
  - o Impact assessment modeling
  - o Other, please specify ...

– **Specify which climate models are currently developed and applied in your group? (more models may be specified)**

– **Which land cover data/ product do you use or have used for your specific model application (tick all that may apply)**
  - o Global and regional datasets IGBP Discover and GLCC (USGS)
  - o MODIS land cover
  - o GLC2000
  - o MODIS VCF
  - o CORINE
  - o NLCD
  - o TERRASTAT
  - o SYNMAP
  - o GLOBCOVER
  - o major ecosystem types according to Olson (1994a, 1994b)
  - o HYDE landcover dataset (Klein Goldwijk et al.)
  - o Ramankutty and Foley's global geospatial dataset

- o National land cover databases
- o FAO statistics
- o in situ
- o Other, please specify ...

− **Could you describe what problems occur when you use current land cover datasets for your model? (Choose two options)**

- o Consistency for the allocation of model parameters
- o Approaches for transformation of land cover data to land surface information
- o Difficulties with data interpolation
- o Difficulties with data aggregation
- o Thematic categories/Plant Functional Types are not sufficiently represented
- o Low temporal resolution and temporal range of input data
- o Low spatial resolution and spatial extend of input data
- o Different definitions used for key-attributes in datasets and models
- o Access and knowledge to updated land cover datasets
- o Thematic accuracy of the land cover datasets
- o Other, please specify

− **How would you estimate the accuracy of the land cover product for your application case?**

- o very good (100-90% accuracy)
- o good (90-80% accuracy)
- o moderate (80-65% accuracy)
- o poor (>65% accuracy)

B. Describe the land cover data requirements

− **At what spatial extent do you apply your model? (more than 1 choice is possible)**

- o Global
- o Continent
- o Country
- o Local study
- o Other, please specify

− **What is the spatial resolution/detail needed for your model application**

Used in current models	Expectations of data needed in 5 years also considering new modeling approaches
o 1-30 m, o 30-100 m o 100 – 300m o 300-500m o 500m-1km, o 1-5km, >5 km	o 1-30 m, o 30-100 m o 100 – 300m o 300-500m o 500m-1km, o 1-5km, >5 km
o < 0.25 degrees latitude x longitude,	o < 0.25 degrees latitude x longitude,

- o 0.25-0.50 degrees latitude x longitude
- o 0.5-1 degrees latitude x longitude
- o 1-5 degrees latitude x longitude
- o 5-10 degrees latitude x longitude
- o 10 degrees latitude x longitude

- o national and regional aggregates/averages
- o other, please specify....

- o 0.25-0.50 degrees latitude x longitude
- o 0.5-1 degrees latitude x longitude
- o 1-5 degrees latitude x longitude
- o 5-10 degrees latitude x longitude
- o 10 degrees latitude x longitude

- o national and regional aggregates/averages
- o other, please specify....

‒ **What type of land cover classes are most important for your application, Choose the 3 options that are of most importance**

Actually used in current models	Expected to be used after 5 years after applying new modeling approaches
o None o Tree cover/forest classes and subcategories o Shrub classes o Herbaceous classes o Mixed vegetation classes o Barren land classes o Agricultural classes o Urban classes o Wetland classes o Other specific classes	o None o Tree cover/forest classes and subcategories o Shrub classes o Herbaceous classes o Mixed vegetation classes o Barren land classes o Agricultural classes o Urban classes o Wetland classes o Other specific classes

‒ **If any, please specify which land surface parameters used in your models are estimated from the land cover data (tick all that may apply)**

Used in current models	Expected to be used after 5 years after applying new modeling approaches
o None o Background (surface) albedo o Soil albedo (non-vegetated part) o Vegetation albedo o Vegetation roughness/ length o Vegetation ratio (climatological monthly cycle) o Leaf area index (climatological monthly cycle) o Forest ratio o Total soil water holding capacity o Plant available water holding capacity o Volumetric wilting point o Soil type and surface texture	o None o Background (surface) albedo o Soil albedo (non-vegetated part) o Vegetation albedo o Vegetation roughness/ length o Vegetation ratio (climatological monthly cycle) o Leaf area index (climatological monthly cycle) o Forest ratio o Total soil water holding capacity o Plant available water holding capacity o Volumetric wilting point o Soil type and surface texture

o Other, please specify	o Other, please specify

– **Specify which model output you use to validate land cover data (tick all that may apply)**

Validation parameter in current models	Expected validation parameter after 5 years after applying new modeling approaches
o None o Radiation balance o Energy Balance o NPP o LAI o Albedo o Vegetation distribution o Vegetation dynamics o Area of (oceanic) ice sheets o Area under permafrost o other, please specify	o None o Radiation balance o Energy Balance o NPP o LAI o Albedo o Vegetation distribution o Vegetation dynamics o Area of (oceanic) ice sheets o Area under permafrost o other, please specify ....

– **Are you using use any other earth observation derived land parameters as direct model input? (tick all that may apply)**

Use in current models	Plan to use / expectations of data needed in 5 years also considering new modeling approaches
o None o Albedo o LAI o Biomass o Fire/burnt area o FAPAR o Vegetation cover fraction o Surface roughness o Snow cover o Vegetation phenology o other, please specify	o None o Albedo o LAI o Biomass o Fire/burnt area o FAPAR o Vegetation cover fraction o Surface roughness o Snow cover o Vegetation phenology o other, please specify ....

– **In which type of thematic information describing human activities/ disturbances or dynamics are you most interested for your model application (choose 3 options)**

Use in current models	Expected to be used after 5 years after applying new modeling approaches
o None	o None

o Loss of forest land (deforestation) o Expansion of urban areas o Expansion of agricultural land o Vegetation phenology (seasonality) o Snow phenology o Fire/burned area o Wetland/water body dynamics o Expansion of barren land/land degradation/desertification o Long-term trends in vegetation distribution o Others, please specify	o Loss of forest land (deforestation) o Expansion of urban areas o Expansion of agricultural land o Vegetation phenology (seasonality) o Snow phenology o Fire/burned area o Wetland/water body dynamics o Expansion of barren land/land degradation/desertification o Long-term trends in vegetation distribution o Others, please specify

– **With respect to the previous question, what are the land cover temporal detail requirements for your application?**

Used in current models	Expectations of data needed in 5 years also considering new modeling approaches
o Daily or finer o Monthly - Quarterly o Quarterly – 6 months o 6 months- o 1 year, o 2 years o 5years o 10 years o 50 years o more than 50 years o other, please specify ...	o Daily or finer o Monthly - Quarterly o Quarterly – 6 months o 6 months- o 1 year, o 2 years o 5years o 10 years o 50 years o more than 50 years o other, please specify ...

C. Data access and delivery

– **Please list which cartographic reference system/projection (i.e., lat/lon grid) would you prefer for you land cover data?**

- o Lat/ long grid
- o Geographic coordinate system
- o (optional) specify geographic coordinate system...
- o Projected coordinate systems
- o (optional) specify projected coordinate system ...

– **What data format is most convenient for you?**

- o ISO19115 metadata standard for geographic information
- o FGDC metadata standards
- o Geography Markup Language (GML)
- o Keyhole Markup Language (KML)
- o OGC Catalogue Services
- o NetCDF

- o HDF, HDF-EOS, NITF
- o GeoTIFF,
- o JPG2000, DTED
- o Adopted standards as propagated by GEO/GEOSS
- o CEOS product format standards
- o Current ESA ERS/ENVISAT/Explorer formats
- o Others, please specify ....

- **What type of delivery mode do you prefer for data access? (tick the 3 most preferable options)**

  - o From delivered media (e.g., DVD)
  - o HTTP links within catalogue
  - o Web services
  - o FTP
  - o Combination of web services and FTP (e.g., request via web service and delivery through FTP)
  - o Web Mapping Services (WMS)
  - o Web Coverage Services (WCS)
  - o Via satellite link
  - o Systematic online delivery
  - o Online via the previous services, but also with subsequent media delivery
  - o Others, please specify .....

D. Other problems and comments

Any other comments to the Land Cover CCI team currently involved in preparing the product specifications for a new global land cover product targeted to support climate modeling

E. Results

The resulting user requirements report will be made available to the climate modeling user community and we are happy to forward it if you provide an email address:

e-mail address:…………..

Appendix C: Key user survey

A. General Information

– **Name and institution/organization of whom completed the survey:**

– **What is your Earth system/ climate modeling focus:**
  o Carbon (stock) modeling,
  o land cover (change) modeling,
  o ecosystem modeling,
  o land surface modeling,
  o vegetation modeling,
  o plant-soil-carbon modeling,
  o nutrient-cycling modeling,
  o coupled earth system modeling (e.g. atmosphere-ocean-biosphere modeling),
  o Impact assessment modeling,
  o Other?

– **Specify which climate models are currently developed and applied in your group (if possible add key reference)?**

– **Which land cover data do you use or have used for your specific model application:**
  o Global and regional datasets IGBP Discover and GLCC (USGS)
  o MODIS land cover
  o GLC2000
  o MODIS VCF
  o CORINE
  o NLCD
  o TERRASTAT
  o SYNMAP
  o GLOBCOVER
  o major ecosystem types according to Olson (1994a, 1994b)
  o HYDE landcover dataset (Klein Goldwijk et al.)
  o Ramankutty and Foley's global geospatial dataset

- o National land cover databases
- o FAO statistics
- o in situ
- o Other, please specify ...

- **How do you evaluate the consistency of the current land cover data with your model requirements?**
  - o sufficient
  - o with some problems
  - o rather insufficient

- **What is the main reason of interoperability problems?**
  - o Temporal resolution and temporal range of input data
  - o Spatial resolution and spatial extend of input data
  - o Different definitions used for key-attributes in datasets and models
  - o Other, please specify

- **Could you describe in more detail what problems occur when you use current land cover datasets for your model?**

- **How would you estimate the accuracy of the land cover product for your application case?**
  - o very good (100-90% sufficient)
  - o good (90-80% sufficient)
  - o moderate (80-65% sufficient),
  - o poor (>65% sufficient)

B. Model specifications: input and output

B.1 Describe your model(s)

- **At what spatial extent do you apply your model? (if required specify for more models)**
  - o Global
  - o Continent
  - o Country
  - o Local study

  – **What the spatial resolution for your model application (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add resolution	o Add resolution	o Add resolution

You may choose from following: 1-30 m, 30-100 m, 100 – 300m, 300-500m, 500m-1km, 1-5km, >5 km, < 0.25 degrees latitude x longitude, 0.25-0.50 degrees latitude x longitude, 0.5-1 degrees latitude x longitude, 1-5 degrees latitude x longitude, 5-10 degrees latitude x longitude, > 10 degrees latitude x longitude, or national and regional aggregates/averages, other (please specify).

  – **What are the land cover temporal range requirements for your application (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add range	o Add range	o Add range

You may choose from following: < 6 months, 6 months- 1 year, 1- 2.5 years, 10 years, 50 years, 100 years, more than 100 years, other (please specify).

  – **What is the shortest temporal simulation step (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add time-step	o Add time-step	o Add time-step

You may choose from following: Hourly, 0.5 days, 1 day, Month, 0.5 year, Year, Decade, Century, other (please specify).

B.2 Describe the land cover requirements

During the Land Cover CCI kick-off meeting, three key areas how land cover observations and data are used in the climate modeling have been identified:

1. As proxy for a suite of land surface parameters that are assigned based on PFTs;

2. As proxy for human activities in terms natural versus anthropogenic and tracking human activities, i.e. land use affecting land cover;
3. As datasets for validation of model outcomes (i.e. time series) or to study feedback effects.

The questions below will address some specific issues related to the identified uses of land cover datasets in your climate models.

B2.1 Land cover as proxy for land surface parameters

– **Specify which plant functional types are estimated from the land cover data (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add PFTs	o Add additional PFTs or classes	o Add additional PFTs or classes

– **Specify which land surface parameters are estimated from the land cover data (if required copy for more models):**

Used in current models	Expected to be used to improve current practice within 1 year	Expected to be used after 5 years after applying new modeling approaches
o Add land surface parameters	o Add additional land surface parameters	o Add additional land surface parameters

– **What are the land cover spatial resolution requirements for parameter estimation in your model application (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add resolution	o Add resolution	o Add resolution

You may choose from following: 1-30 m, 30-100 m, 100 – 300m, 300-500m, 500m-1km, 1-5km, >5 km, < 0.25 degrees latitude x longitude, 0.25-0.50 degrees latitude x longitude, 0.5-1 degrees latitude x longitude, 1-5 degrees latitude x longitude, 5-10 degrees latitude x longitude, > 10 degrees latitude x longitude, or national and regional aggregates/averages, other (please specify).

- **In case you (would) use/require multi-temporal land cover data for parameter estimation, which time steps would you prefer (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add time-step	o Add time-step	o Add time-step

You may choose from following: Monthly, half-year, Year, 5 years, decade, century, other (please specify).

- **Are you (or will be) using any other earth observation derived land parameters as direct model input (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add time-step	o Add time-step	o Add time-step

Potential options: Albedo, LAI, Biomass, Fire/burnt area, FAPAR, Snow cover, other (please specify).

B2.2 Land cover as proxy for human activities

- **Specify which type of thematic information describing human activities or disturbances are you interested in for your model application (if required copy for more models):**

Used in current models	Expected to be used to improve current practice within 1 year	Expected to be used after 5 years after applying new modeling approaches
o Add human activities/ disturbances	o Add additional human activities/disturbances	o Add additional human activities/ disturbances

Potential options: conversion of forest to agriculture, urbanization, other land cover and land use change (please specify), other (please specify).

− **What are the spatial resolution requirements for land cover and land use change estimates for your model application (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add resolution	o Add resolution	o Add resolution

You may choose from following: 1-30 m, 30-100 m, 100 – 300m, 300-500m, 500m-1km, 1-5km, >5 km, < 0.25 degrees latitude x longitude, 0.25-0.50 degrees latitude x longitude, 0.5-1 degrees latitude x longitude, 1-5 degrees latitude x longitude, 5-10 degrees latitude x longitude, > 10 degrees latitude x longitude, or national and regional aggregates/averages, other (please specify).

− **What temporal detail/frequency for tracking human activities and land use change observations would you require (if required copy for more models):**

Used in current models	Expected to be used to improve current practice (such as from new land cover data, i.e. Land Cover CCI products)	Expectations of data needed in 5 years also considering new modeling approaches
o Add time-step	o Add time-step	o Add time-step

Choose from following: Monthly, half-year, Year, 5 years, decade, century, other (please specify).

B2.3 Land cover for validation of model outcomes

− **Specify which model parameters you would like to validate using land cover and related observation data (if required copy for more models):**

Used in current models	Expected to be used to improve current practice within 1 year	Expected to be used after 5 years after applying new modeling approaches
o Add validation parameter	o Add validation parameter	o Add validation parameter

– **For each parameter, could you please provide more specific information on what level of detail you require by using the following table:**

Parameter	Information need from land cover observations	Spatial extend (i.e. local, national, global)	Spatial resolution (30 m, 1 km, 1 deg.)	Temporal resolution (hourly, daily, monthly, yearly)

– **What other (spatial) data sets are of importance for your application that should be consistent with the land cover dataset? (tick all that may apply)**

- o Digital elevation model
- o Transportation infrastructure (i.e. road network)
- o Water use
- o Soil data
- o Groundwater heights
- o Lake and reservoir level
- o Snow cover
- o Glacier and ice caps (extent)
- o Fraction of absorbed photosynthetically active radiation (FaPaR)
- o Biomass
- o Leaf area index (LAI)
- o Fire disturbance
- o Soil moisture
- o Climate data
- o Meteorological data
- o Other, please specify ...

C. Data access and delivery

– **Please list which cartographic reference system/projection (i.e., lat/lon grid) would you prefer for you land cover data?**

– **What data format is most convenient for you?**

- o ISO19115 metadata standard for geographic information
- o FGDC metadata standards
- o Geography Markup Language (GML)
- o Keyhole Markup Language (KML)

- o OGC Catalogue Services
- o NetCDF
- o HDF, HDF-EOS, NITF
- o GeoTIFF, JPG2000, DTED
- o Adopted standards as propagated by GEO/GEOSS
- o CEOS product format standards
- o Current ESA ERS/ENVISAT/Explorer formats
- o Others, please specify ....

– **What type of delivery mode do you prefer for data access?**

- o From delivered media (e.g. DVD)
- o HTTP links within catalogue
- o Web services
- o FTP
- o Combination of web services and FTP (e.g., request via web service and delivery through FTP)
- o Web Mapping Services (WMS)
- o Web Coverage Services (WCS)
- o Via satellite link
- o Systematic online delivery
- o Online via the previous services, but also with subsequent media delivery
- o Others, please specify .....

– **How you evaluate the current retrieval process of your input data?**

- o Easy, data is easy to retrieve and is free to use
- o Moderately easy, data is easy to retrieve but is not free
- o Poor, data is not easy to retrieve, and is not free to use

– **What do you consider to be the current limitations in the retrieval process of land cover datasets? (tick all that may apply)**

- o Ease of access
- o Costs
- o Transparency
- o Aging of knowledge
- o Quality/reliability
- o Speed – time of delivery
- o Historical data access
- o None
- o Others, please specify ....

D. Other problems and comments

Any other comments to the Land Cover CCI team currently involved in preparing the product specifications for a new global land cover product targeted to support climate modeling