Integration of new Space Weather Precursor Services into the SSA Data Center:

- Regional Aurora Forecast
- Ionospheric Scintillation Monitoring Services

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Pablo Beltrami - etamax
Ralf Keil - etamax
Unai Martinez - etamax
Vicente Navarro - ESA/ESAC

Kirsti Kauristie - FMI
Philippe Yaya - CLS
Yannick Béniguel - IEEA

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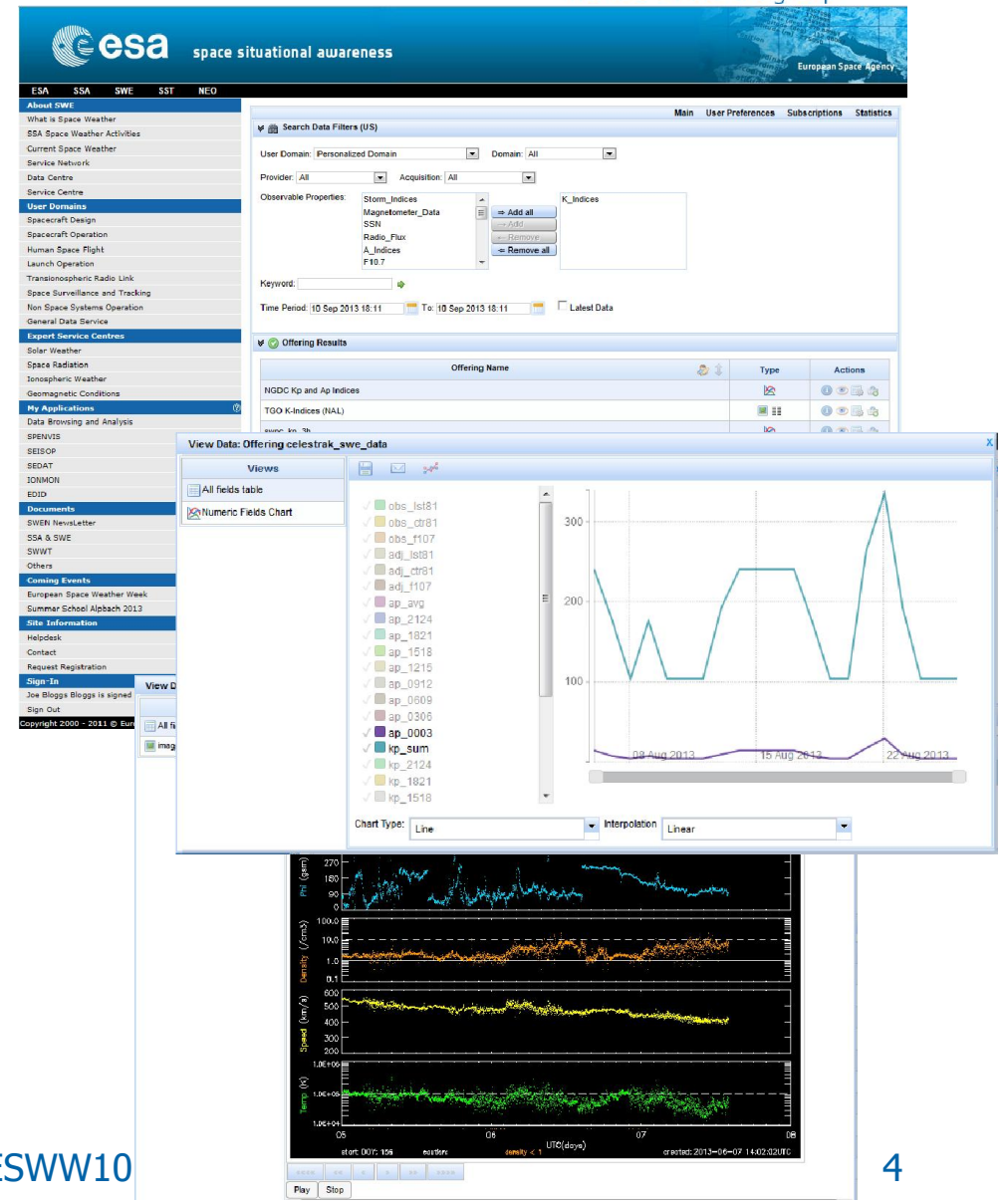
Objectives of the project

- ESA activity "SSA DC-IV Prototype Pilot Data Centres project"
  - WP-SWE New Space Weather Precursor Services
  - Project Team: etamax (WP leader), CLS, FMI, IEEA
- Develop and integrate two new service solutions into the SSA SWE Portal
- Regional Aurora Forecast (RAF) service
- Ionospheric Scintillation Monitoring (ISM) service
- Reuse or extend existing services provided by the SWE Portal

Overview of the SSA SWE Data Center

- Developed in the SSA DC-II project
- Provides a central portal for Space Weather Data
  - Main SSA data server
  - Provides a central Service Oriented Architecture (SOA) framework
  - Provides functionalities for:
    - User management
    - Data import form ext. resources
    - Data provision and subscription
    - Data plotting
    - Alert subscription



Regional Aurora Forecast (RAF) service solution

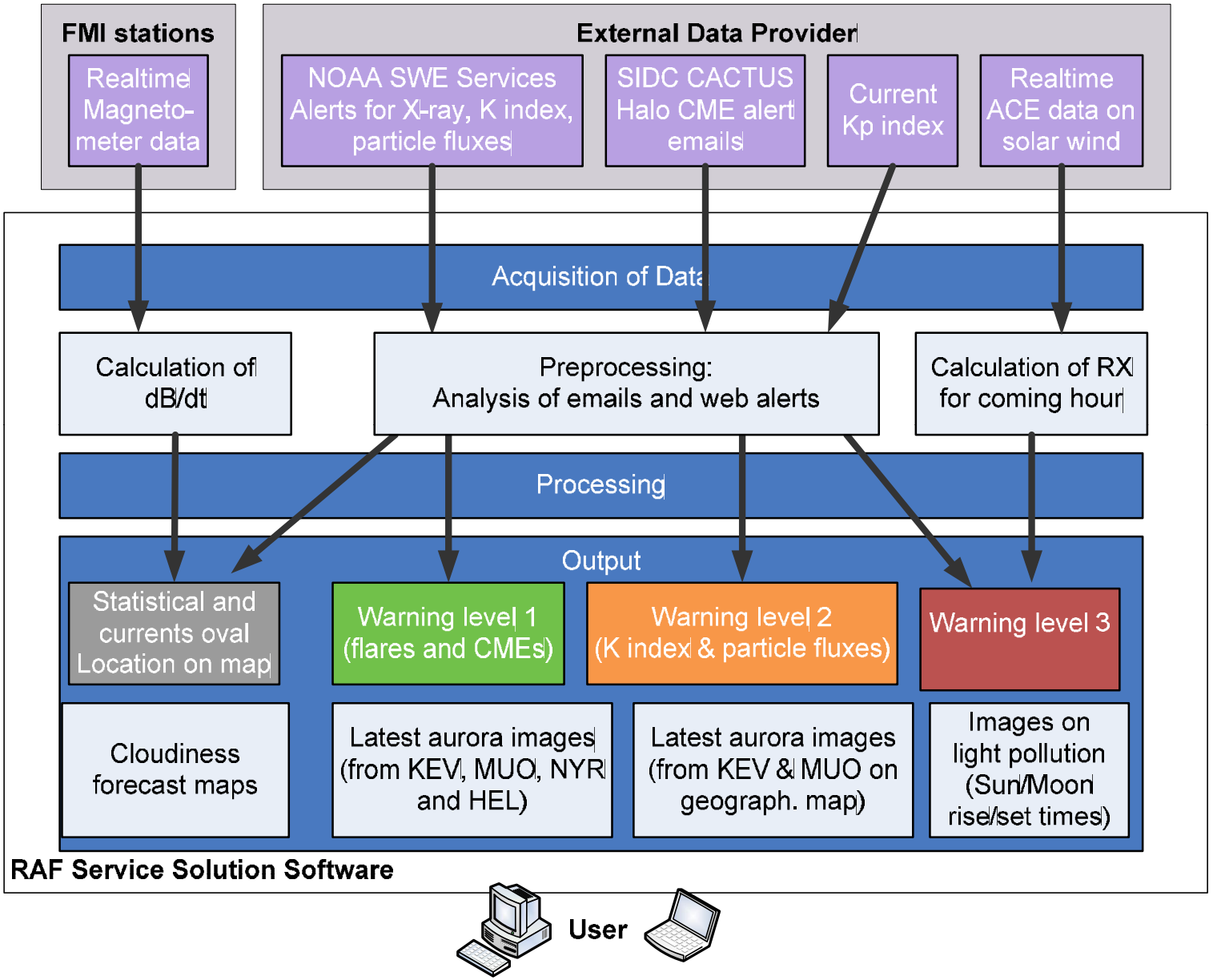
The RAF service

- Service products
  - Current situation: maps of auroral oval location (observations + stat. model)
  - Forecast: maps of auroral ovals with lead times 0-3h, 3-6h, 6-9h, 9-12h
  - Occurrence level for auroras
  - Current/Forecast situation: associated maps on cloudiness situation
  - Current/Forecast situation: associated visibility information on day times & dark times (Sun and Moon rise & set times)

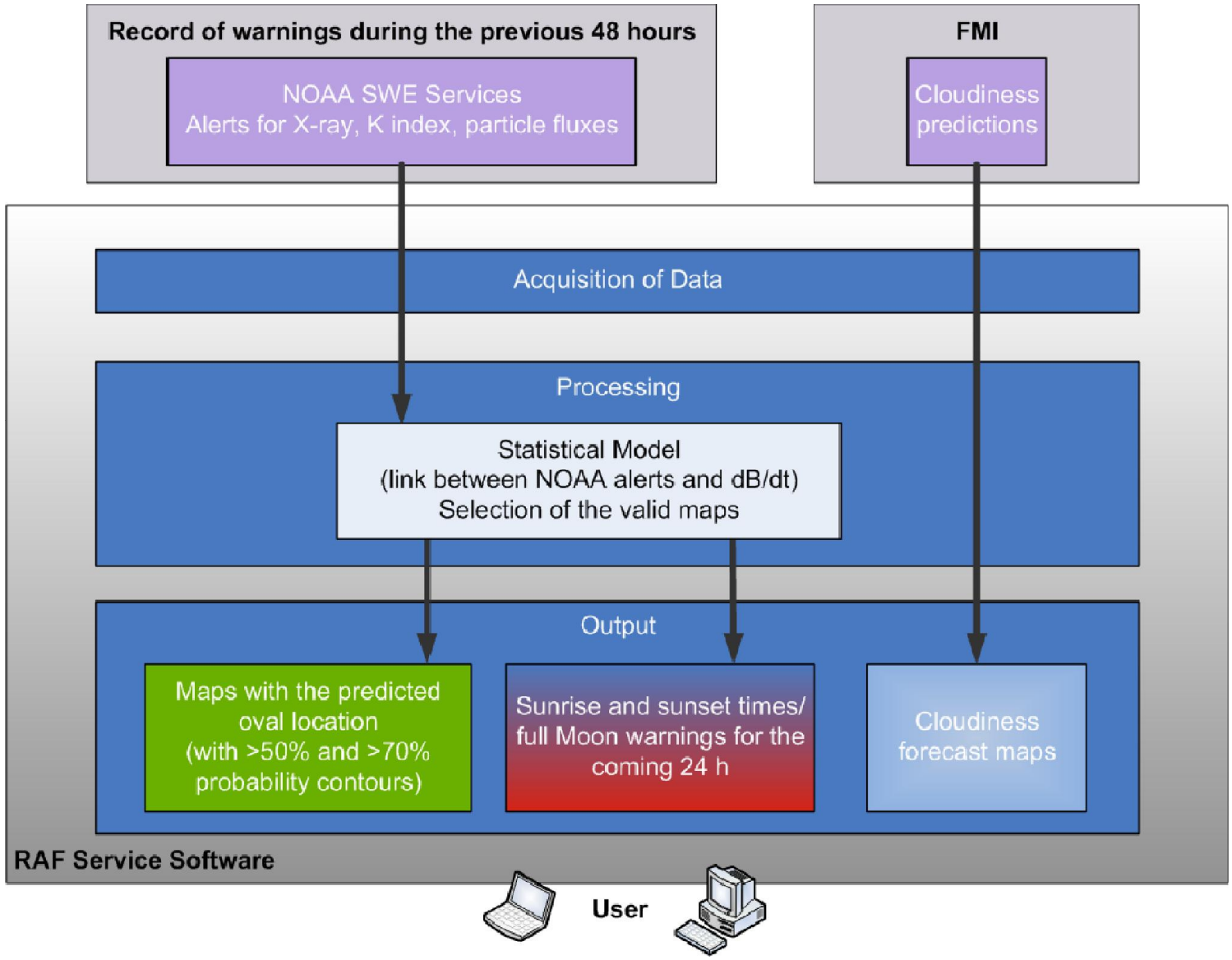
- Data Sources
  - NOAA: alerts for X-ray, K index, current Kp index, particle fluxes
  - SIDC CACTUS Halo CME alert emails
  - Realtime ACE data on solar wind parameters
  - Realtime data from FMI magnetometer stations NUR, HAN, OUJ, MUO, KEV

- (Pre-)Processing algorithms on
  - auroral monitoring/forecasting for Fennoscandia and in preselected regions
  - visibility conditions, light pollution, cloudiness information

Service Approach: Auroral Monitoring



Service Approach: Auroral Forecasting



Service Mock-up (Auroral Monitoring)

esa space situational awareness

ESA SSA SWE NEO SST SWE SWE2 poeut News Publisher News

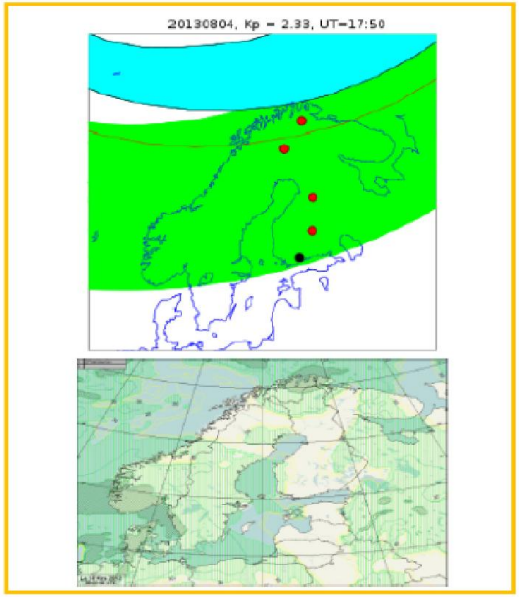
- **About SWE**
  - What is Space Weather
  - SSA Space Weather Activities
  - Current Space Weather
  - Service Network
  - Data Centre
  - Service Centre
- **User Domains**
  - Spacecraft Design
  - Spacecraft Operation
  - Human Space Flight
  - Launch Operation
  - Transionospheric Radio Link
  - Space Surveillance and Tracking
  - Non Space Systems Operation
  - General Data Service
- **Expert Service Centres**
  - Solar Weather
  - Space Radiation
  - Ionospheric Weather
  - Geomagnetic Conditions
- **Federated Services**
  - SIDC
  - KSO
  - SWACI
  - TGO
  - AVIDOS
- **My Applications**
  - SWENET
  - SPENVIS
  - SEISOP
  - SEDAT
  - IONMON
  - EDID
  - SIDC
  - AVIDOS
  - SWACI
  - TGO
  - KSO
- **Coming Events**
  - European Space Weather Week
- **Links**
- **Site Information**
  - Helpdesk
  - Contact

Regional A

Regional Auroral Service: Current situation (YYYYMMDD, hh:mm UT)

- How this service works? (→*RAFIntro*)
- Information about auroras (→ *GeneralInfo*)

- Forecast with 0-3 h lead time (→ *Forecast3*)
- Forecast with 3-6 h lead time (→ *Forecast6*)
- Forecast with 6-9 h lead time (→ *Forecast9*)
- Forecast with 9-12 h lead time (→ *Forecast12*)



Up: Location of the auroral oval based on current geomagnetic observations. Greem shading shows dB/dt disturbance regions and cyan the statistical model (based on Kp)
Down: Current cloudiness situation

Additional information from NOAA and SIDC space weather alerts during previous 48 hours:

X-ray flare observed 38 hours ago
Global geomagnetic conditions quiet
Solar wind conditions quiet at ACE

- Below we list the auroral camera stations used in this service with their geographic locations and Sun rise times. For each station also the potential appearance of Full Moon is given.

KEV (XX °N, XX°E, Auroral latitudes): Sun rise time: YYYYMMDD, hh:mm UT; Full Moon rise time: YYYYMMDD, hh:mm
MUO (XX °N, XX°E, Auroral latitudes): Sun rise time: YYYYMMDD, hh:mm UT; Full Moon rise time: YYYYMMDD, hh:mm
NYR (XX °N, XX°E, Sub-Auroral latitudes): Sun rise time: YYYYMMDD, hh:mm UT; Full Moon rise time: YYYYMMDD, hh:mm
HEL (XX °N, XX°E, Sub-Auroral latitudes): Sun rise time: YYYYMMDD, hh:mm UT; Full Moon rise time: YYYYMMDD, hh:mm

Ionospheric Scintillation Monitoring (ISM) service solution

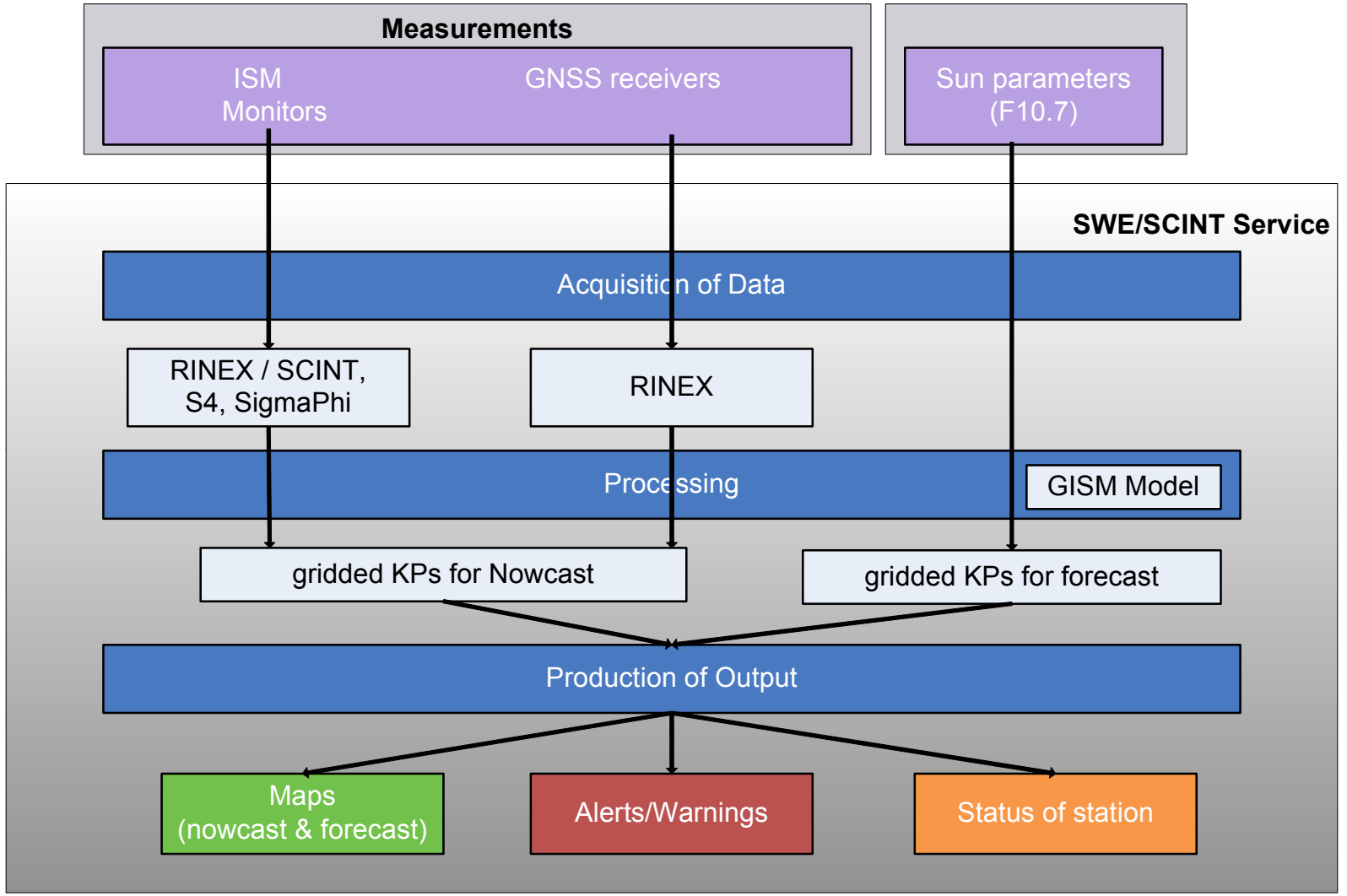
The Ionospheric Scintillation Monitoring service (ISM)

- Service products
  - Nowcast and Forecast of key parameters
    - ionospheric scintillation indices , S4, SigmaPhi, TEC maps
  - Worldwide & regional maps (at station level)
  - Alerts (for nowcasts) and warnings (for forecasts)
  - In case of missing data from stations products are generated from IEEA/GISM model

- Data Sources
  - Free GNSS networks (mainly IGS)
    - RINEX data (1s sample rate) → selection of core network stations
  - MONITOR ISM sensor network (equat./mid-lat./high-lat.)
    - RINEX data (50 Hz sample rate), SCINT Scintillation data

- Processing: Performing calibration computations and scintillation evaluations
  - Calibration of scintillation index from GNSS data with ISM data
  - Calibration allows to determine relevant Key Parameters
  - Execution of the GISM (Global Ionospheric Scintillation Model)

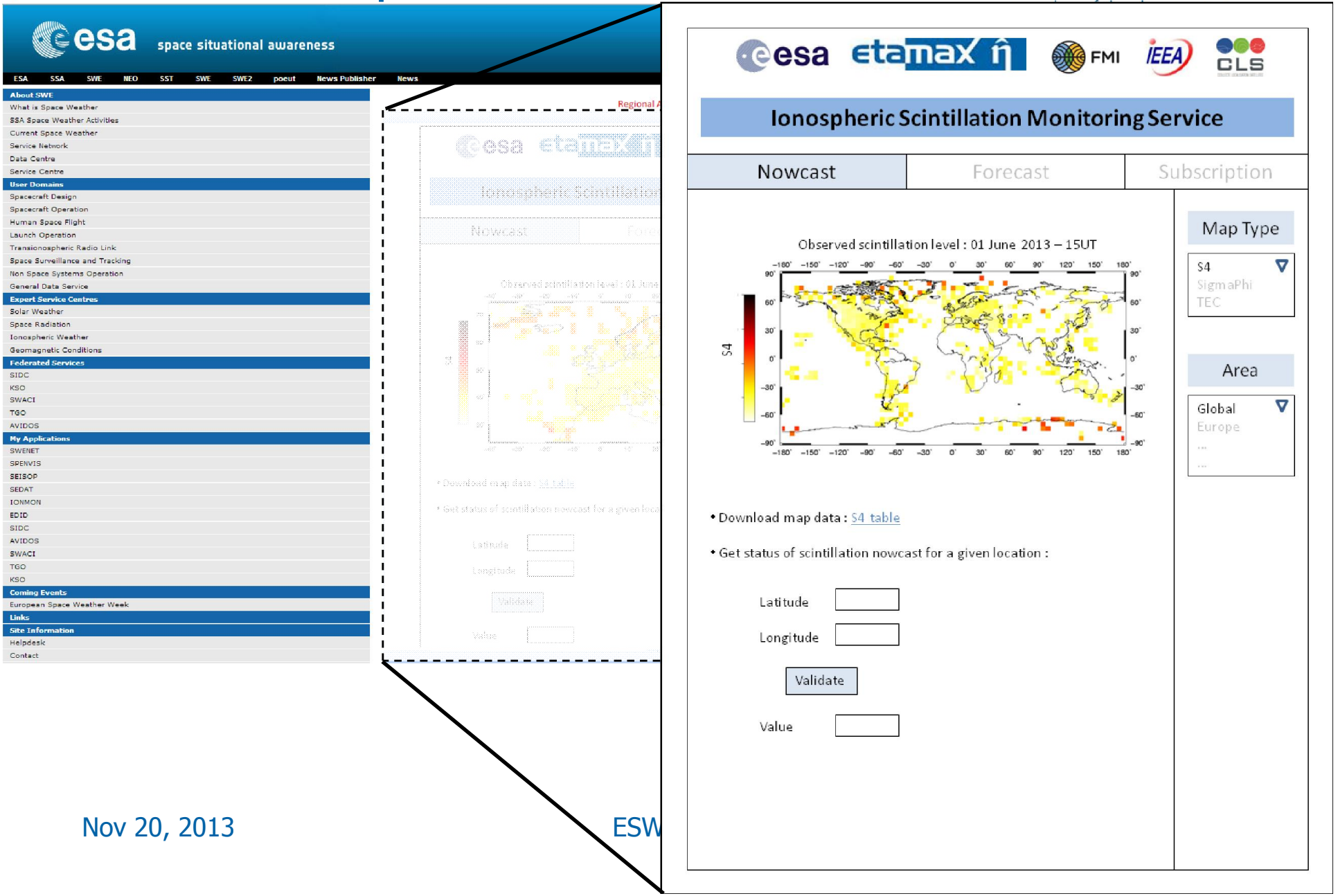
Service Approach



KPs: S4, SigmaPhi, vTEC
@grid cell (5x2.5 deg2)**
+ corresp. level of conf.

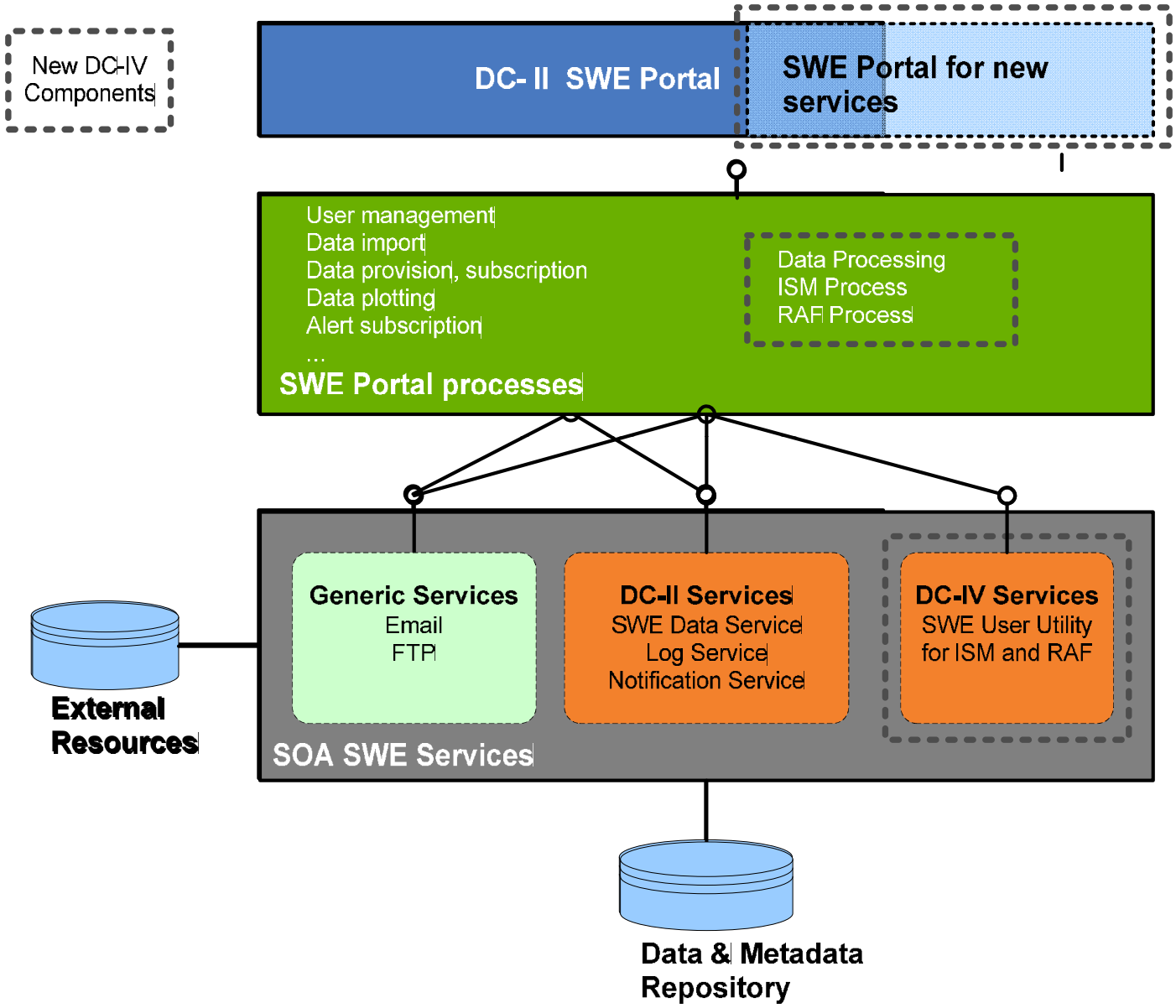
User

Service Mock-up



Integration of Service Solutions into the SWE data Center

Integration approach



Integration approach

- Make use of existing functionality
  - Access data providers
    - FTP, email, http data access
  - Use common SSA SWE Database
- Implement a service wrapper for legacy code
  - Integrate the algorithms as SOA services
- Business Processes orchestrate the use of the SOA services
- The products generated by each service solution are stored back into the SWE database
- New areas in the portal GUI are implemented to display the products generated

Main challenges

- Service solutions will be developed using the SOA approach
  - Reuse of existing components is maximised
- Development of new user interfaces for the SWE Portal
  - The web portal needs to be extended to provide access to the new functionalities
  - both interfaces for external users and for the service administrators
- Integration of the services and its interfaces into the COSIF framework
  - The services will be integrated into the SSA framework at Redu, Belgium, validated and tested to ensure the quality of the results

Summary & Conclusions

- The DC-IV WP-SWE projects implemets two new service solutions
  - RAF service solution provides monitoring and forecast information for Auroral activity in the Fennoscandia area
  - ISM service solution provides scintillations monitoring and forecast worldwide
- The service solutions are integrated into the SSA Space Weather Portal
- Re-use of common components is maximised
- The same approach can be applied to future services expanding the SSA SWE Portal

etamax space GmbH

Frankfurter Straße 3 d
D-38122 Braunschweig
Tel +49 (0)531.866688.0
Fax +49 (0)531.866688.99

www.etamax.de
Email info@etamax.de